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The equity debate: distributional impacts of individual transferable quotas

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Abstract

The twin goals of economic efficiency and social equity often seem at odds, particularly in the debate over two marine policy approaches: firm-level regulation of inputs and outputs (''command and control'') and individual transferable quotas. This paper examines the debate over social equity in a US fishery that transitioned from command and control to individual transferable quotas—the mid-Atlantic clam fishery. The analysis draws on 17 years of data on fishing trips, vessel ownership, tradable property rights ownership, and output market shares. The results show that no segment of the industry was disproportionately adversely affected by the regulatory change; however, they also demonstrate the emergence of a new sector in the industry, which is predominantly made up of former small-scale harvesters.

1. Introduction

Given the extensive economic literature on the theoretical advantages of tradable property rights over command-and-control systems (input/output regulation), the persistence of traditional regulatory mechanisms in US fishery policy appears incongruous. In US fisheries, a tradable property right takes the form of an individual transferable quota [ITQ], or individual fishing quota, denoting a share of

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the annually specified total allowable harvest.[1] Much of the resistance to the use of individual transferable quotas in the US centers on the concern that ITQs will change participants' relative positions in the fishery—in particular the fear that small-scale fishermen will be disadvantaged relative to larger producer. Despite the economic arguments that ITQs produce gains in the *aggregate*, this fundamental debate over the *distribution* of gains from increased efficiency, and of losses from restructuring, remains a persistent debate [1–5].

ITQ-based systems were implemented in five US marine fisheries by the mid-1990s.[2] Controversy over their re-distributive effects led to legal actions against the federal marine regulatory agency, the National Marine Fishery Service, and to a moratorium on the use of ITQs in any additional US marine fisheries in the 1996 reauthorization of Magnuson–Stevens Fishery Conservation and Management Act [2,6].[3] Expiration of the moratorium leaves fisheries managers with the difficult issue of evaluating the distributional issues surrounding ITQs. Existing legislation guiding fishery management reveals a preference for policies that are considered to be equitable [6–9]; thus, an examination of this issue is timely.

In what follows, we present evidence on the changes in industry composition that occurred in the mid-Atlantic surf clam (*Spisula solidissima*) and ocean quahog (*Arctica islandica*) fishery,[4] which was regulated first with command and control and then with tradable property rights. In contrast with earlier studies that focused on individual fishing *vessels*, this analysis is based on a unique data set that permits differentiation of *firms* based on their size and on their degree of integration (defined by vertical integration with processing sector [processor], horizontal integration across boats [fleet], or no integration [independents]). These data allow us to explicitly address the concern that ITQs will drive small-scale fishermen out of the fishery. Second, it allows us to identify an important change in the industry: the transition of many small-scale fishermen into a new business model, that of leasing ITQs to other harvesters. Our firm-level analysis shows that there is little evidence that the small-scale harvester was disadvantaged relative to the larger-scale harvester. Additionally, the results show that a vessel-level analysis misrepresents the change in industry composition, a result that has fueled much of the policy debate in the US.

[1]The Magnuson–Stevens Act states that an individual fishing quota shall be considered a permit and does not constitute a right or title to any fish *before they are harvested*.

[2]ITQs were implemented in the middle Atlantic surf clam and ocean quahog, the North Pacific halibut, the North Pacific sablefish, and the South Atlantic wreckfish fisheries.

[3]The 1996 reauthorization of the Magnuson–Stevens Act, the main legislation governing fisheries regulation, imposed a moratorium on the use of tradable property rights in any additional U.S. marine fisheries until the year 2000 [Title III, Section 303, 104–297]. During the 106th Congress, the moratorium was extended until October 2001. The Magnuson–Stevens Reauthorization Act of 2000, introduced on June 29, 2000, by U.S. Senator Olympia Snowe (R-Maine), extended the moratorium on the new implementation of tradable property rights in U.S. fisheries until October 1, 2003. The moratorium has since expired.

[4]Unless otherwise noted, discussion refers to both surf clams and ocean quahogs.

2. Evaluation of individual transferable quotas

The theoretical literature on ITQs demonstrates the potential for substantial gains in productive efficiency and substantial reduction of over-capitalization in fisheries, see [10–13]. The elimination of redundant capital has been empirically validated in several analyses of ITQ systems around the world. (See for example [14–16]). Despite the efficiency gains of ITQs, the issues of equity and social impacts of regulation remain critical to policy evaluation [6,9,17,18].

The concern over the balance of equity and economic efficiency is best summarized by the National Standards for Conservation and Management. Standard Four states (see 16 USC. §§ 1851(4):

> If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges…

Most of the evaluations of ITQs have verified economic gains in the *aggregate*, which has left the equity question unanswered. Opponents of ITQs in fisheries interpret the empirical evidence of reduction of capacity to mean that "small producers" will be faced with economic realities that make exiting the industry their only viable option, leading to domination of the industry by large fleet owners and firms that are vertically integrated through harvesting and processing. The costs of these disputes include both lawsuits and considerable burdens on the managerial process. Two examples of lawsuits over this issue are: *Sea Watch International, et al. v. Secretary of Commerce,* 762 F. Supp. 370 (1991) and *Alliance Against IFQs, et al. v. Secretary of Commerce* 84 F.3d 343 (9thCir. 1996). In the fishery examined in this paper, the plaintiffs in *Sea Watch International, et al., v. Robert Mosbacher* argue that the implementation of ITQs violated the national equity and fairness standard, National Standard Four of the Magnuson–Stevens Act, because it was intended to drive a particular group of individuals—single-vessel owners and small-fleet owners—out of fisheries.

The policy debate over tradable property rights in fisheries, therefore, centers on the issues of whether and how tradable permits alter the *composition* of the industry from the prevailing structure under traditional command-and-control regulation. Unless implemented in an emerging fishery free of prior regulation, industry stakeholders' positions on ITQs will be based on their position under existing regulations—which in most US fisheries is some form of command and control, broadly defined. Therefore, in this paper we examine how the fishery composition changes using command and control as the baseline, acknowledging that this initial welfare distribution may in fact not be socially or economically optimal.

The mid-Atlantic surf clam and ocean quahog fishery was subject to command-and-control regulation from 1979 through 1989, but has been governed by ITQs since 1990. The tension between small-scale harvesters and larger-scale harvesters and processors has been a recurrent theme in fisheries management and was a

volatile issue in the clam fishery [19,20]. This paper uses 17 years of input and output data as well as firm identifiers to determine whether the implementation of ITQs favored one type of firm (independent, fleet, or vertically integrated) over another, as reflected in industry composition. This case study has two important implications. First, while there is empirical evidence of a change in industry composition, analysis shows that ITQs did not produce an inequitable outcome in this fishery, implying that the debate over ITQs should be refocused on issues of firm behavior under policy change and ITQ design. Second, this case study identifies an important way in which firms adapt their behavior—giving up harvesting in favor of leasing their ITQs to other harvesters; this vital sector must be included in any accurate welfare analysis of the industry.

3. Empirical evidence of changes in industry composition

With annual production valued at over $48 million, the mid-Atlantic surf clam and ocean quahog fishery provides almost the entire supply for domestic processed clam products [21]. The outputs of the surf clam fishery include canned clam chowder, canned minced clams, canned sauces and juices, and breaded products.

The ocean quahog is found further from shore and at greater depth than the surf clam. Both clam species are sessile species that are harvested using a hydrologic dredge. The main difference between harvesting the two clam species is that the length of the hose to harvest the ocean quahog is greater than that to harvest surf clams, and the length of a ocean quahog trip is longer than a surf clam trip (typically 24 h compared to 8 h). The same vessels can be used for both species; the only necessary gear change is the change to a longer hose before an ocean quahog trip. Location of the clam beds, as well as the varying properties of the beds (for example, average size of clam and quality of meat), is common knowledge in the industry. The clam biomass is located off the shores of Virginia, Maryland, Delaware, New Jersey, New York, Rhode Island, Massachusetts, and Maine, with commercial stocks concentrated off the shore of northern New Jersey.

3.1. Regulatory history

The surf clam was harvested as early as 1870, but significant quantities were not harvested until the 1950s, with effort expanding rapidly between the 1950s and early 1970s. This growing pressure on the resource was exacerbated by a shock to the clam population when anoxic waters off the coast of New Jersey killed off large portions of the surf clam stock. In 1977 the creation of the Mid-Atlantic Fishery Management Council, under the framework of the Magnuson–Stevens Fishery Conservation and Management Act (Public Law 94–265), provided the mechanism to regulate effort in the fishery. The first approach used by the management council was limiting access and establishing a total allowable catch. The limited access system granted licenses to vessels that had been harvesting surf clams but prohibited any new vessels from harvesting surf clams.

As fishermen raced for a share of the total catch, the average allowable fishing hours fell from 36 hours a week in 1979 to 6 h a week in 1984. The increasing stringency of surf clam regulations left the vessels idle for increasingly longer portions of the harvesting season. The cost of idle capital, as well as technological innovation in the processing sector, displaced fishing effort to the previously underutilized ocean quahog. From 1980 to 1984 the total ocean quahog harvest was 16,269,458 bushels. The total harvest of ocean quahogs over 1985–1989 was 22,879,392, an increase of 40.6% over the previous 5-year total.

By the mid-1980s, rapid growth in harvesting capacity and resulting inefficiencies prompted a debate over the establishment of tradable property rights. While a tradable property rights system for surf clams was being negotiated, beginning in the mid-1980s, it was clear that allocations would be based on some form of historical harvest quantities.[5] A critical aspect of the allocation mechanism was that the property right would be distributed on a *vessel* basis, not directly to the *vessel owner;* thus, the property right asset was embedded in the vessel asset. While some boats that were licensed for the surf clam/ocean quahog fishery were not being actively used, now there was an incentive to put them into production in order to establish a catch history. As a result, while the number of *allowed* vessels could not change under limited access policies, the number of *active* vessels increased immediately prior to the implementation of ITQs.

Debate over property rights in the clam fishery spanned a decade, and a central concern was that independents would be disadvantaged in their allocation [20,23]. Amendment Eight: Fishery Management Plan for the Atlantic Surf Clam and Ocean Quahog Fishery, finalized the allocation formula [24].[6] The surf clam allocation included vessel catch (80%) and vessel capacity (20%), while the ocean quahog allocation was based solely on vessel catch. For vessels harvesting surf clams the historical catch was equal to the vessel's total harvest over 1979–1988 (counting the years 1985–1988 twice and dropping the vessel's worst 2 years). Each vessel's catch ratio was the vessel's historical catch divided by the sum of all vessels' historical catch. The vessel's cost factor was equal to the product of the vessel length, width and volume. The vessel's cost ratio was equal to the vessel's cost factor divided by the sum of the cost factors over all vessels.

For vessels harvesting ocean quahogs the historical annual catch was equal to the vessel's average annual harvest over 1979–1988 (dropping the vessel's worst year). Each vessel's catch ratio was the vessel's historical annual catch divided by the sum of all vessels' historical annual catch. The vessel's initial ocean quahog allocation was equal to the vessel's catch ratio.

The system was designed such that the ITQ is the percentage of the total allowable catch held by the vessel. Once the total allowable catch has been determined (in

[5]The formal negotiations over ITQs began with a discussion paper written and circulated by the management council in 1986 [22].

[6]Amendment Eight: Fishery Management Plan for the Atlantic Surf Clam and Ocean Quahog Fishery was approved by the Mid-Atlantic Fishery Management Council in cooperation with the National Marine Fisheries Service and the New England Fishery Management Council in 1988.

quantity of bushels) the vessel's allocation is its ITQ (in percentage) multiplied by the total allowable harvest. The allocation is the quantity of bushels that the vessel has a right to harvest. There were no restrictions placed on concentration of ownership. Prior to initial implementation the claim to ITQs was tied to each currently active vessel; after implementation the property right was disaggregated from the vessel and could be traded as a separate asset. Amendment Eight permitted a firm to retain ownership of its ITQ even if it terminated harvesting and sold its capital, allowing the firm to lease its quota to harvesters.

ITQs were implemented in 1990, and led to a significant reduction in the number of vessels in the industry, as predicted by economic models of tradable property rights in fisheries. Initially, some industry participants tried to create a niche for brokers of allocations; however, this sector never fully developed and transfers have been dominated by bilateral transactions between harvesters and owners of ITQs.

3.2. Data

The data used in this research were compiled from the vessel records of every fishing trip made by every vessel during the years 1980–1999. These vessel records are mandated by fishery regulations and are referred to as vessel logbooks.[7] This information on each fishing trip was matched with vessel license records that include vessel characteristics.[8] The concept of "firm" is used for the individual, partnership, or company that owns either vessels active in the fishery or ITQs or both. To differentiate capital and harvests by firm type, we matched each registered vessel owner with its unique firm identifier using a file of true owners.

True owners are defined according to the basic concept of a firm—decision-making agents that own vessels and decide how to use them. An individual owner could own multiple vessels where each vessel could be registered under a different owning corporation. An owner database that maps corporations into parent firms was used to distinguish between truly distinct firms, and was developed by McCay and Creed for the surf clam and ocean quahog fishery (updated periodically). This owner file, which maps vessels onto individual firms, is crucial to assessing the change in fleet composition over time. The creation of the owner database is detailed elsewhere [25], and an outline is provided in the Appendix. Firms were then characterized as processor owned (vessels and/or ITQs owned by a firm that processes clam products) or not processor owned. A firm not owned by a processor was then further classified by the number of vessels it owned while it was harvesting clams: independent firms own less than three vessels and fleet firms own more than two vessels. This delineation was used to reflect the dominant social stratification in the fishery [20].

[7]Logbook data were provided through a research agreement with the Northeast Fisheries Science Center of the National Marine Fisheries Service.

[8]Information contained in the logbooks for each trip includes: time spent fishing, time spent traveling, quantity of each species caught. Relevant data from vessel license records include vessel characteristics: year built, gross registered tonnage, vessel's registered owner.

4. Composition of industry

This section presents empirical evidence of the differences in this clam fishery under the two policy approaches. First, changes in overall fleet composition demonstrate the impact of ITQs on industry structure. Composition of the industry can itself be measured using three sets of indicators: first, the absolute number of active vessels and firms in the industry; second, the distribution of active firms in the industry by type; third, the distribution of the actual harvest by type of firm. The issue of the distribution of ITQ ownership by firm type is discussed in the next section.

The most striking change after the implementation of property rights was a significant reduction in the number of vessels in the industry. This decrease is viewed differently by economists and policymakers. Economists typically interpret this rationalization as a social gain based on the assumption that less efficient producers left the industry. In contrast, some policymakers, environmental groups and industry members have portrayed this exit of vessels as evidence that industry participants were "forced out," and therefore as a social loss. However, counting all active vessels greatly overestimates both the number of firms in the industry and the number that then exited from it. There are two reasons the change in number of vessels misstates the change in participation. First, a significant portion of the reduction in active vessels is due to firms' decisions to consolidate harvesting on fewer vessels. Second, owners of ITQs who cease harvesting but participate in the fishery by leasing their ITQs are overlooked by a vessel-level analysis.

4.1. Vessel and firm participation

Fig. 1 measures industry participation in three ways, showing how markedly different conclusions could be drawn. The line graph (axis on the right) shows the number of vessels active in the industry (Number of Boats). The bar chart (axis on the left) shows the total number of firms active in the industry, including those actively harvesting surf clams (Harvesting Firms) and those leasing their ITQ allocations to harvesters (Non-Harvesting Firms). As a whole, this chart reflects the changes in both the amount of harvesting capital and the number of firms in the fishery caused by the implementation of ITQs.

As shown in Fig. 1, there was a notable reversal in trends in the number of active vessels. In the early 1980s, during command and control, there was a contraction in the industry and the number of vessels fell almost 8% between 1980 and 1983. This downward trend reversed during the negotiation of property rights in the mid-1980s. Between 1983 and 1986 there was a dramatic increase of 23% in the number of active vessels, as firms put previously inactive vessels into service in order to establish a claim under the property rights system. (Recall that prior to implementation, the claim to property rights was associated with the vessel, not the vessel owner; therefore, a firm needed to have vessels harvesting at the time of implementation in order to stake its claim for ITQs.) After implementation of ITQs, on the other hand, there was an immediate 41% reduction of capital in the fishery (from 131 vessels in

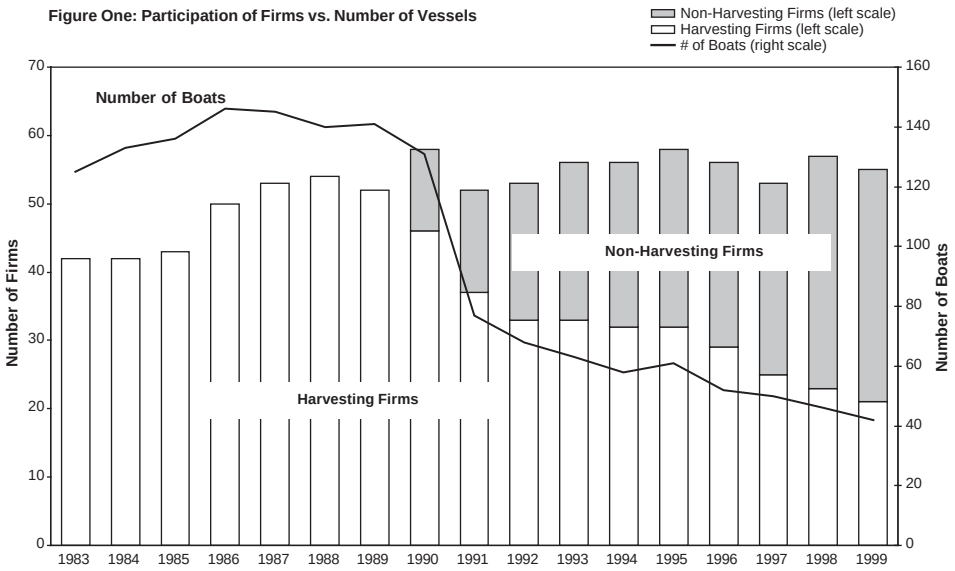

Fig. 1. Participation of firms vs. number of vessels. *Source*: National Marine Fishery Surf Clam and Ocean Quahog Logbooks and True Owners file.

1990 to 1977 in 1991). Over the 9 years of ITQs, there was a continued decline in the number of vessels harvesting surf clams and ocean quahogs,[9] declining in total 68% from 1990 to 1999.

From a social equity perspective, however, it is not the number of vessels per se that is of interest, but rather the number of participants, or firms, in the industry. It is the number and characteristics of participants (i.e. firms) that determines the composition of the fishery and hence if the regulation is in violation of National Standard Four. Measuring the change in the number of vessels shows us how firms change their utilization of capital—for example, increasing capital to gain property rights—but not the social impact on those people for whom the fishery is a business investment. We can see in Fig. 1 that while many vessels exited the industry after property rights, the total number of firms in the industry reveals a more complex story.

Under command-and-control regulation, vessel owners could participate in the industry only as harvesters. The change in the number of harvesting firms is shown by the height of the white bars in Fig. 1. Between 1983 and 1986 there was a 19% increase in number of firms harvesting clams, as vessel owners used this opportunity to gain property rights. The number of firms that harvested clams fell 26% from 1986 to 1991 and 43% from 1991 to 1999. Although this decrease in number of firms is far less than the decrease in number of vessels, it, too, overstates the exit of firms from the industry.

[9]Henceforth surf clams and ocean quahogs are collectively referred to as clams.

Since the implementation of property rights, some firms have made a transition from harvesting clams to a new business model where they no longer harvest but instead generate revenue by leasing property rights to harvesting firms. These firms are shown as the shaded bars in Fig. 1 (Non-Harvesting Firms), which represent an increasingly large proportion of the industry. In total there has actually been an increase of almost 6% in the number of distinct participants in the industry, including both harvesters (who may hold ITQs) and non-harvesters who hold ITQs.

Analyses examining only the change in the number of harvesting vessels miss important shifts in the way firms participate in the industry. Using just the number of vessels—without matching those vessels to their owners—estimates only the change in capital in the industry, not the change in the number of participants. As shown with these data, the number of harvesting firms does not necessarily result in a decline in the total number of firms in the industry. Analyses that include only vessels as a measure of participation produce social welfare estimates that are likely to be misleading.

4.2. *Composition of industry by firm type*

Firm type is critical for understanding the impact of regulatory change on industry structure. For this analysis, firms that own one or two vessels and are not vertically integrated with the processing sector are defined as independents; firms with three or more boats that are not vertically integrated are defined as fleets; and firms that harvest clams and are vertically integrated are defined as processors.[10] The impact of regulatory change on the type of firms in the industry is illustrated in Fig. 2, which shows the change in the distribution of firms over time. The white area at the bottom is the number of independent harvesting firms, which increases in the mid-1980s and rapidly declines after 1990—leading observers to believe that small fishermen were "forced out" of the industry. The next layer is the number of fleets (horizontally integrated harvesting firms). Above them on the graph are the processors (vertically integrated harvesting firms). The total number of harvesting firms is then the total of these three areas. Looking only at these harvesting firms, we see an upward trend in the number of firms during property rights negotiations and a decline after policy implementation, as well as a shift from independents toward integrated firms. In 1983, 74% of harvesting firms were independents, 10% were fleet owners, and 16% were vertically integrated firms. By 1999, this distribution of *harvesting firms* had shifted to 57% independents, 19% fleet owners, and 24% vertically integrated firms—again giving the appearance that independent firms had been disadvantaged relative to fleet owners and vertically integrated processors. However, including *all* firms in the industry (including both harvesters and non-harvesters leasing their allocations) yields a strikingly different picture.

The number of non-harvesting firms is represented by the shaded area, beginning in 1990. (Prior to 1990, non-harvesting firms were by definition not part of the

[10]This definition of firm size was used because it delineates the conflicts among harvesters that have historically existed in this fishery [20].

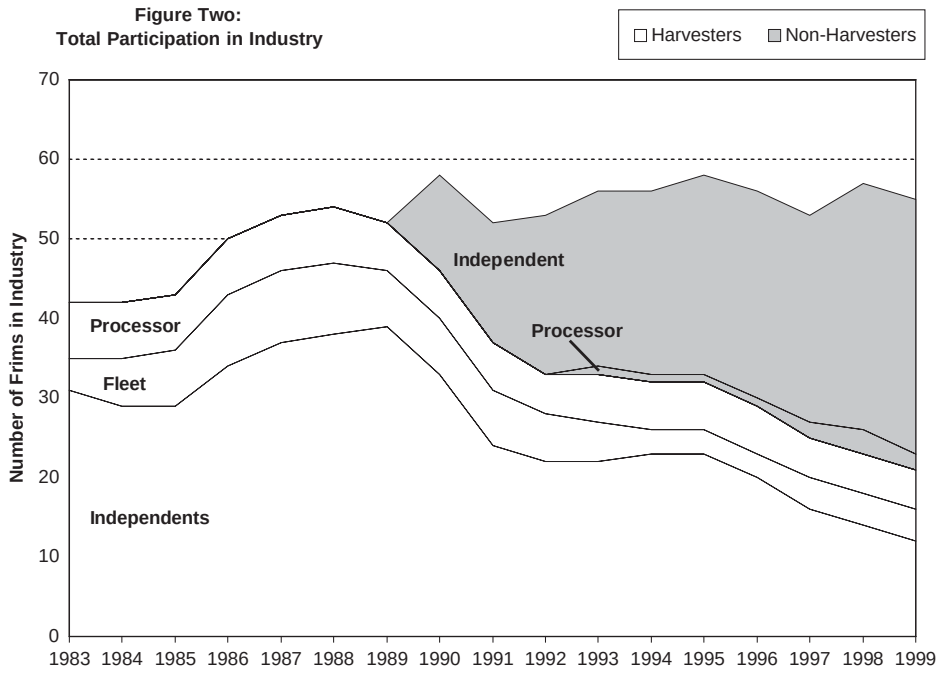

Fig. 2. Total participation in industry by firm type. *Source*: National Marine Fishery Surf Clam and Ocean Quahog Logbooks and True Owners file.

fishery.) Non-harvesting firms are those firms that own allocations but do not harvest; they consist mainly of independent firms that discontinued harvesting after receiving ITQs, with a smaller number of processors that own property rights but do not harvest. Non-harvesters are a new sector in the fishery after 1990, and the number of independent non-harvesting firms grew substantially from 1990 through 1999, offsetting the decline in the number of independent harvesting firms. In 1999, the distribution of *all firms* in the industry was 80% independents, 7% fleet owners, and 13% vertically integrated firms, showing little change from the situation in 1983.

Much of the rhetoric opposing ITQs uses the argument that independents are "forced out" under ITQs, and the reduction of capital in ITQs fisheries is often pointed to as evidence. It is thus informative to compare firm exit under the two policies. Over the entire 1983–1999 period, those firms that ceased harvesting, either to become non-harvesting lessors of allocations or to exit the industry altogether, were exclusively independents, with the exception of three vertically integrated firms. There is no significant difference between the types of firms leaving the harvesting sector before and after the policy change—weakening the claim that ITQs have an unfairly negative impact on independent firms.

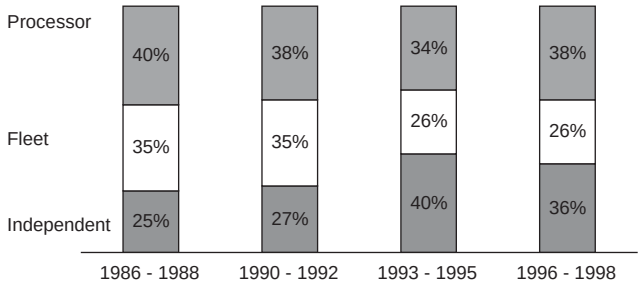

Fig. 3. Share of surf clam catch by firm type. *Source*: National Marine Fishery Surf Clam logbooks and True Owners file. *Note*: Percent of catch is the average over the years indicated for the given firm type.

4.3. Harvest by firm type

Beyond participation in the fishery (measured by number of firms), changes in the distribution of harvests across firm types are of concern to regulators. Prior to implementation of ITQs, processors took the largest share of annual surf clam harvests (see Fig. 3). During restructuring immediately after ITQs, the distribution of harvests across firm types did not significantly change. The data indicate that, counter to fears, independents increased their share of harvests during the ITQ period; by the 1996–1998 period, the relative position between fleets (larger-scale harvesters) and independents had reversed, with independent firms leading fleet firms by ten percentage points.

In summary, independent firms showed the ability to compete successfully under ITQs—a picture that is distorted by looking solely at active vessels, not active firms. Under ITQs, firms could participate either as active harvesters or as lessors of allocations; ignoring the latter overstates the exit of firms from the industry, clouding the effect of regulatory change on industry structure. Fig. 2 shows that this new strategy was particularly important to small, independent firms, many of which chose to cease harvesting and lease their allocations to other firms. These non-harvesting firms are a crucial component of the fishery, and must be incorporated into policy evaluations in order to provide a complete picture of the impact of regulatory change.

5. Changes in allocation holdings

The previous section discusses changes in industry composition due to policy change. Here we will look at changes in ownership of the new asset—the tradable property right itself. Opponents of tradable property rights have asserted that the market for quotas would present a disadvantage to small firms, thus leading to excessive market power and domination by large firms. This concern, which has not been adequately addressed due to difficulties in differentiating across firm types, has

Table 1
Change in concentration of surf clam property rights ownership, 1990–1999

Top three owners	Top four owners	Top five owners	Top ten owners
5.79%	7.94%	11.12%	11.56%

Source: Mid-Atlantic Fishery Management Council Surf Clams and Ocean Quahog Allocation Annual Records.

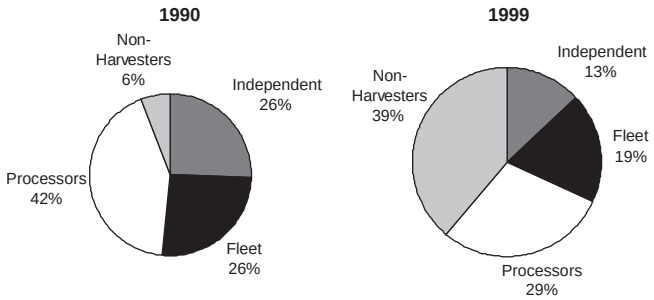

Fig. 4. Distribution of property right ownership across firm type. *Source*: Mid-Atlantic Fishery Management Council Surf Clams and Ocean Quahog Allocation Annual Records and True Owners file. *Note*: Deviation between quantity of ITQ ownership (Fig. 4) and harvest (Fig. 3) is due to leasing of quota.

led to propositions to limit the trading of property rights in fisheries.[11] Far from ensuring equity, however, restricting trade in property rights has the potential to entrench firms in their current (pre-policy change) positions, undermining the efficiency gains from property rights [26].

Simple statistics in Table 1 and Fig. 4 show two types of changes in ownership of tradable property rights: change in concentration and change in ownership by firm type. The data indicate that once property rights could be traded, there was a small increase in concentration of ownership. This increase, however, is surprisingly small given the time span. The top three holders of quota have increased their share of the total allocation only 6%, while the top ten owners have increased their share by 12%. These changes do not provide strong evidence of increasing concentration that could facilitate market manipulation.

Distribution of property rights across firm types is central to the equity question. Fig. 4 compares this distribution between the first year of ITQs (1990) and the last year for which data are available (1999). The four categories of ownership are:

[11]Proposed reauthorizations introduced language either prohibiting trading of property rights (Senate bill 2832, Senator Olympia Snowe (R-Maine)) or limiting trade (Senate bill 2973, Senator John Kerry (D-Massachusetts)).

independent harvesters, fleet owners (horizontally integrated), processors (vertically integrated), and non-harvesters (firms that own quota but do not harvest).

First, the share owned by processors has significantly decreased from 42% in 1990 to 29% in 1999. Likewise, the share owned by independent harvesters has declined, from 26% to 13%. This has been balanced by the large increase in the property rights owned by non-harvesting firms (including both independents and vertically integrated firms that discontinued harvesting) from 6% to 39%—primarily due to the dramatic shift of independent harvesters into this sector. Again, when these non-harvesting firms are taken into account, the supposed marginalization of small independent firms is thrown into question. Any analysis of the impact of regulatory change must incorporate this new sector or risk mischaracterizing the transitions in the industry.

This analysis covers the transitions in the fishery under command-and-control and ITQs through the year 1999. The data over these years suggest trends that are contrary to standard criticisms of ITQs. Over time, the concentration of ownership will continue to evolve in response to fluctuations in the economic conditions in the fishery.

6. Recommendations for ITQ design

These analyses, demonstrating the relationship between firm behavior and changes in industry composition, are particularly relevant to the design of ITQ systems for US fisheries, now that the moratorium on their use has expired. First, comparisons of regulatory options must consider both the amount of capital and the number of firms in a fishery in order to accurately assess the impact of regulation. Creating a registry of firms owning capital prior to allocating ITQs would create an accurate picture of industry composition by firm type, and make it possible to track the emerging sector of firms that lease ITQs but do not harvest. Second, linking catch history to vessel owners rather than to individual vessels would ensure that independent firms retained the right to ITQs, even if their capital holdings are acquired by larger firms during the negotiation period—a particular problem if larger firms have better information about the direction of policy change. Last, free and equal access to information about regulatory change is crucial to ensure that no firms are disadvantaged by asymmetric information about the value of future ITQs.

7. Conclusion

The objective of this paper is to answer a critical question at the heart of the current debate over tradable property rights: Are the economic gains from ITQs unfairly redistributed from one group to another? To explore this question, there is no better place to look than the surf clam industry, which was the first US federal marine fishery to undergo the transition from command-and-control regulation to ITQs. On balance, the claim that ITQs unfairly harm "small" fishermen, forcing

them out of the fishery to the benefit of larger fleets and vertically integrated processors, is not borne out by the evidence.

Empirical analysis yields three significant results, all of which belie the supposed inequitable effects of tradable property rights. First, the pronounced decline in the number of active vessels in the fishery masks the fact that far fewer *firms* actually exited the industry; focusing on the actual economic actors involved shows considerably less socioeconomic dislocation than is implied by vessel-level observations. Second, the share of harvesting firms that were independents, as well as the share of actual harvests taken by those independents, were not adversely affected by the change in regulatory policy, providing more evidence that small fishermen were able to maintain or even expand their economic importance in the fishery. Third, while property rights owned by independent harvesting firms have decreased over the 1990–1999 period, this decrease is due to the emergence of the non-harvesting firms, largely consisting of previously independent harvesters. Finally, analysis of firms that exited the fishery entirely shows that the *type* of firm choosing to exit did not change from the period of command-and-control regulation to the period of ITQs.

Together, these results demonstrate that the introduction of tradable property rights did not lead to a redistribution of welfare across different types of participants in the industry relative to the prior management period. The most crucial lesson is that in predicting and assessing the effects of policy change, it is the firm—not the vessel—that is relevant from a social perspective.

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Appendix. Creation of ownership database

The "true owner" files were created to track the actual owners of licensed, active surf clam vessels (SF-1 and SF-7 license) and ocean quahog vessels (SF-6 license). The license files of the National Marine Fishery Service contain the names of those who apply for and renew vessel licenses in these fisheries. We asked vessel owners to review this list, which is public information, and to give us the names of the "true owners", including partners, of each vessel. We used telephone surveys as well as in-person interviews. Additional ownership information was ascertained by attending

council meetings, interviewing industry representatives, and field observations in the primary clam ports and processing locations. For example, during the 2000 update we visited 11 port cities and interviewed the majority of both independent harvesters and fleet owners, approximately one half of the harvesting processors, and an additional two processors that do not harvest. This approach is reasonable in a small industry such as this clam fishery, where the social relationships and economics are very closely related [27]. We focused on the fishing household as the economic unit (following [28]). Using multiple crosschecks, we are confident that we have a high degree of accuracy in determination of the owners, although we do not claim to identify all relationships between kinships and silent partnerships.

This process was used to create the database in 1984–1985, and updated in 1987, 1989, 1991 and 2000. For additional information on this type of research process see [25,27,29–32].

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